Space Weather Technical Forecast

Issued on Thursday, 06 April 2023 at 12:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout. Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with the new region on the southeast limb producing an M3 flare, peaking at 06/0553 UTC. There are three sunspot regions on the visible disc. AR3270 currently appears to be the largest and most complex region on the disc and has previously exhibited a delta spot in the intermediate spots although this has now faded. However, given that the new region rotating onto the southeast limb has already produced an M-flare, this suggests greater complexity than can currently be seen.

No Earth directed CMEs have been seen in available satellite imagery.

Solar Wind / Geomagnetic Activity: The solar wind as observed by DSCOVR at L1 has shown a steady decline as the recent High Speed Stream (HSS) fades. Wind speeds eased from around 470 km/s to near 380 km/s. Density has been around average to slightly below. Magnetic field strength, Bt, has been weak throughout, below 6 nT. The north-south component, Bz, varied weakly between +/-5 nT. The Phi angle has been mostly negative (towards the Sun). Geomagnetic activity has been Quiet to Unsettled.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, has been at background levels. The high energy electron flux (greater than 2MeV), as measured at GOES16, reached high levels at the diurnal maximum period with a peak of 3210 pfu at 05/1625 UTC. Electron fluence climbed very slightly to reach the Active threshold by 06/0900 UTC, with 9.2e7 integrated pfu recorded at 06/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is most likely to be Low, but with a chance of Moderate activity, either from the new region on the SE limb or from AR3270 in the southwest.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs expected. The recent HSS from either coronal holes 89 or 90 has now faded, with wind speeds at slow-ambient levels. In the absence of any CMEs, wind speeds are expected to remain at or near this level for much of the period. Coronal hole 91 may start to show some HSS influence at the end of Day 4 (09 Apr), but this is more likely to occur on the following day.

Geomagnetic activity is expected to be Quiet to Unsettled, perhaps Active later on Day 4 if we do see the HSS.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) is at background levels and is likely to remain so, in the absence of significant flare activity. Electron flux values are likely to continue at mostly moderate to high levels. Electron fluence is likely to be

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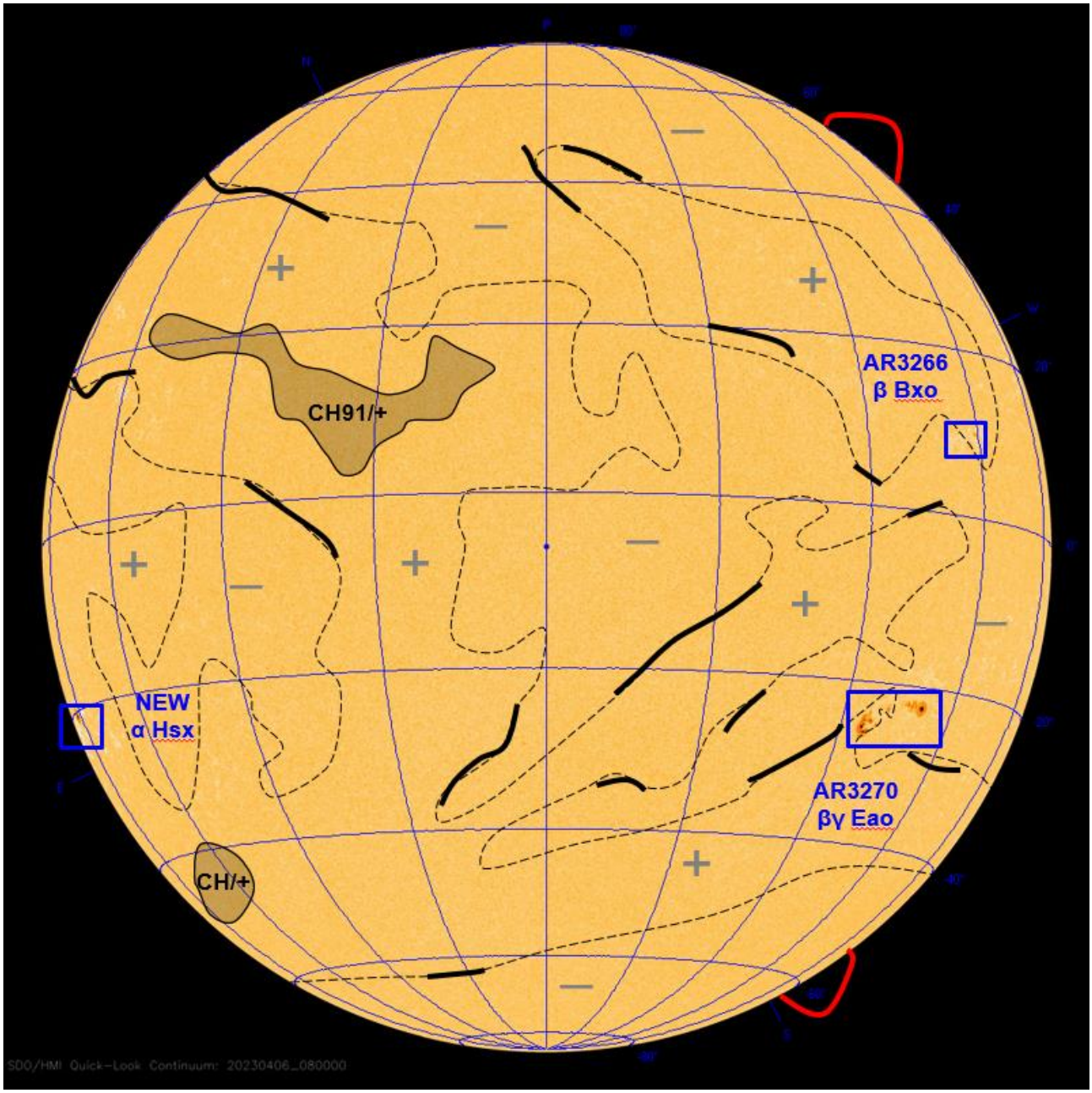
at or near the Active (1e8 integrated pfu) threshold, perhaps increasing slightly through the period.

Figure 1. Solar Analysis Valid 06/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs expected.

The recent HSS from either coronal holes 89 or 90 has now faded, with wind speeds at slow-ambient levels. In the absence of any CMEs, wind speeds are expected to remain at or near this level for much of the period. Coronal hole 91 may start to show some HSS influence at the end of Day 4 (09 Apr), but this is more likely to occur on the following day. On the previous rotation this feature gave a weak HSS on the equivalent of 10 Apr, but the leading edge appears to be a little further ahead this time around suggesting the possibility of a slightly earlier arrival. This coronal hole is positive however, which is not favoured for geomagnetic response near the March equinox.

Geomagnetic activity is expected to be Quiet to Unsettled, perhaps Active later on Day 4 if we do see the HSS.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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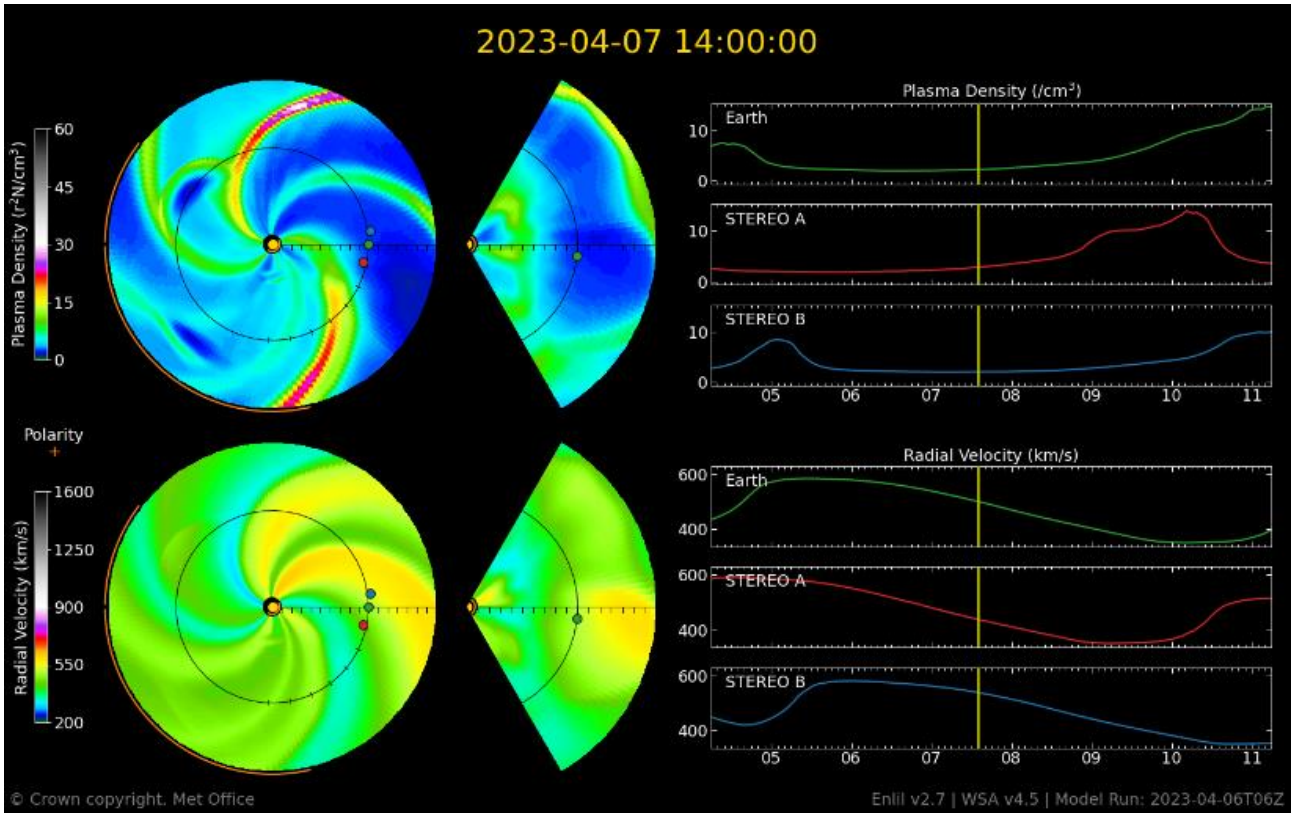
Figure 2: MOSWOC Enlil showing a much slower decline from the HSS than we have seen in reality. As a result, Enlil is currently forecasting wind speeds aroun 150 km/s too high.



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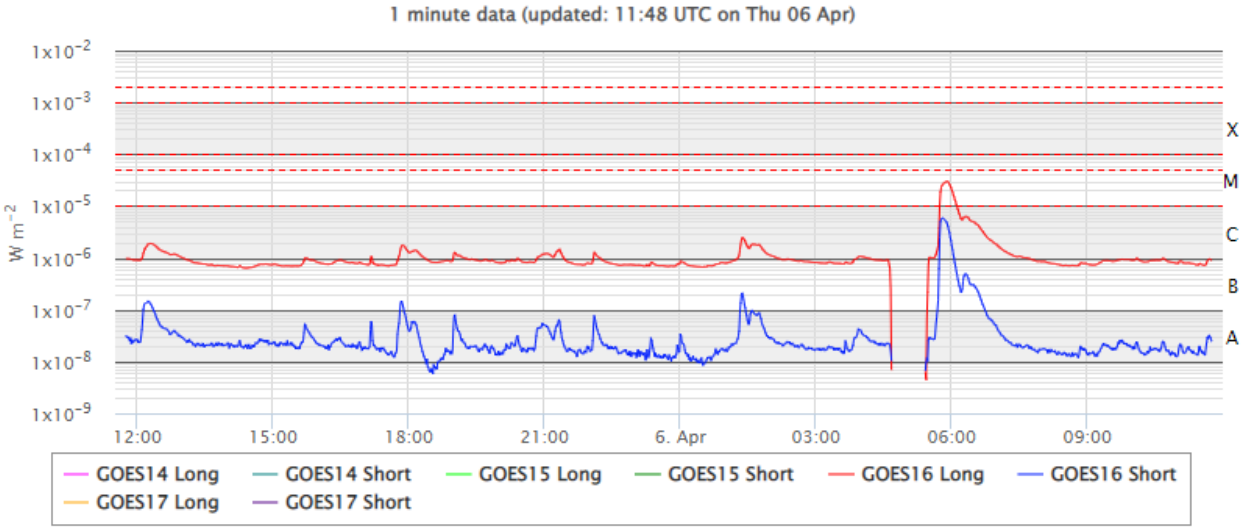
Radio Blackouts - X-Ray Flares:
Solar activity has been Moderate, with the new region on the southeast limb producing an M3 flare, peaking at 06/0553 UTC. Activity is most likely to be Low, although there is a chance of further M-class flares in the coming days.

There are three sunspots currently on the visible disc. AR3270 currently appears to be the largest and most complex region on the disc, and has previously exhibited a delta region in the intermediate spots although this has now faded. However, the new region rotating onto the southeast limb has already given an M-flare, which suggests greater complexity than can currently be seen. The classification is likely to be revised as it rotates further onto the disc and gives us a clearer view. AR3266 is small and simple.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: X-ray flare trace showing the M3 flare from the new region on the southeast limb.



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux (greater than 10MeV), as observed by GOES-16, is most likely to remain at background levels pending any significant sunspot development. There is an extremely slight chance of protons reaching the S1 level, most likely from AR3270 which is in a good position to connect with Earth should a larger flare occur from this region. The new region on the southeast limb cannot yet be fully assessed, but is unlikely to give a proton response at Earth from its current location during this period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	3	3	3	3
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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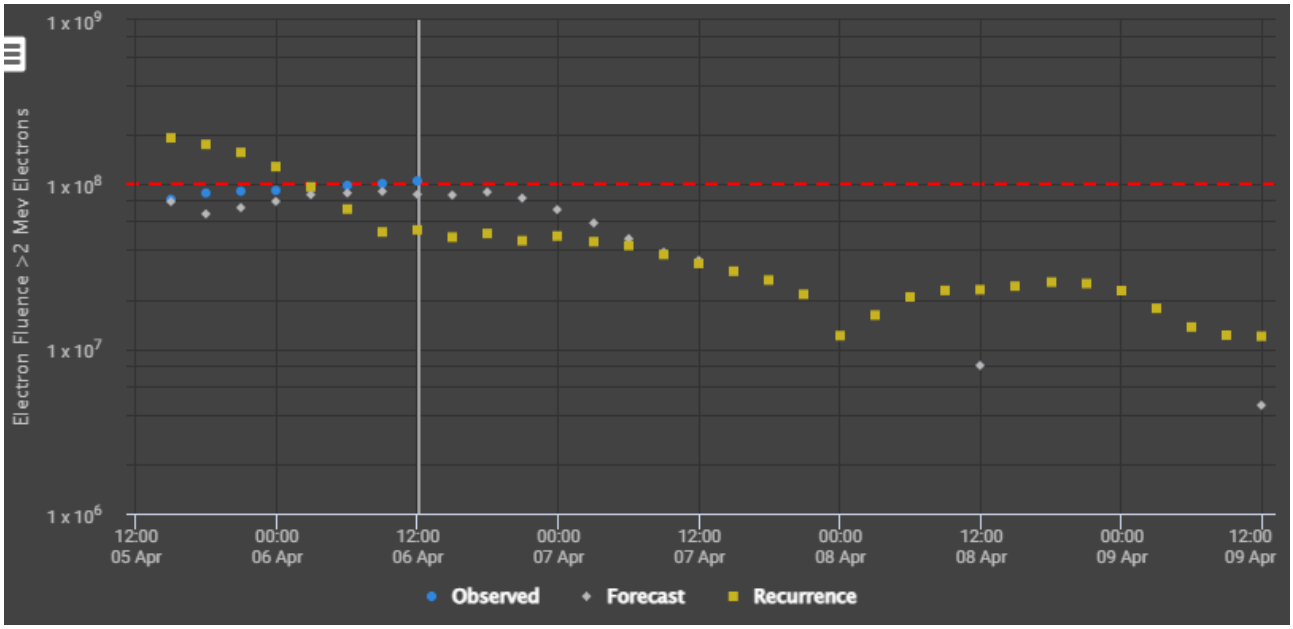
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) is forecast to oscillate between moderate and high (1000 pfu) levels through much of the forecast period. As the solar wind has now recently eased, the pressure on the radiation belt will also ease allowing it to relax towards GEO. The British Antarctic Survey Radiation Belt Model (BAS-RBM) is currently suggesting higher energy electron density at lower orbits, which could then give an increase in electron flux at GEO through the next day or so as the belt relaxes. As such, the flux is likely to continue peaking at high levels although there is low confidence in the magnitude of this peak.

Electron fluence has been at relatively steady levels and has recently reached the Active threshold. It seems likely that fluence will remain at or near the Active threshold through the coming days, but with the possibility of a rise in the next day or two if there is increased electron density at lower orbits as described above. That said, MOSWOC REFM is forecasting a decline through the next three days so there is some uncertainty in this forecast.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	80	60	60
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM is suggesting a downward trend in fluence. It currently seems more likely that fluence will remain near or above the Active (1e8 integrated pfu) threshold.



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